PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 20050536	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/ES2005/000075	International filing date *(day/month/year)* 15.02.2005	Priority date *(day/month/year)* 16.02.2004
International Patent Classification (IPC) or both national classification and IPC INV. F16H37/08		
Applicant GOMA AYATS, JUAN RAMON		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 8 sheets

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16.12.2005	28.06.2006
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer Vogt-Schilb, G Telephone No. +49 89 2399-8917

BEST AVAILABLE COPY

10/587552
IAP11 Rec'd PCT/PTO 27 JUL 2006

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/ES2005/000075

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-27 as originally filed

Claims, Numbers

1-19 as amended (together with any statement) under Art. 19 PCT

Drawings, Sheets

1/9-9/9 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

   These elements were available or furnished to this Authority in the following language: , which is:

   ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).

   ☐ the language of publication of the international application (under Rule 48.3(b)).

   ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

   ☐ contained in the international application in written form.

   ☐ filed together with the international application in computer readable form.

   ☐ furnished subsequently to this Authority in written form.

   ☐ furnished subsequently to this Authority in computer readable form.

   ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

   ☐ the description, pages:

   ☐ the claims, Nos.:

   ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-19
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-19
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-19
	No:	Claims	

2. Citations and explanations

   see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

Reference is made to the following documents:
D1: FR2303206 A
D2: WO02/50452 A
D3: FR2482692 A
D4: US4823640 A

1. Claim 1

The document D1 is regarded as being the closest prior art to the subject-matter of claim 1, and shows (the references in parentheses applying to this document):
An input shaft (I) which is connected to a core input shaft (A) and a core output shaft (B) of a variator (40) through a dual gearbox with multiple ratios (IB11, IB12, IA11,IA12) and an output shaft (Q) which is connected to a core input shaft (A) and a core output shaft (B) through a dual gearbox with multiple ratios (QB11,QB12, QA11,QQ12) . Thus D1 discloses the features B) and C) of claim 1.
The belt variator (40,50) is used in both directions in successive ranges.
The subject-matter of claim 1 differs from this known multiple range variator in that the variator comprises two differentials both connected to the core input and core output shafts and a variator connecting the reaction shafts of both differentials.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as improving the range of the variator.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:
From D3 the CVT comprises the features A) of claim 1. However there is no indication in the prior art that this CVT can be used instead of a pulley variator in D1.

2. Independent Claim 2

The document D2 is considered to represent the closest prior art to claim 2.
On figure 11 the Variator (3) is connected between the two branches connecting both differentials. The invention as claimed in claim 2 differs therefrom in that reduction stages (6 and 7b) are direct coupled and the reduction stages (5 and 7a) are plurality ratios speed changing units.
This is considered to be not obvious because a range gear is generally added behind a CVT.
Hence, the solution to the problem of adding more ranges providing wider CVT ratios proposed in claim 2 of the present application is considered to be new and involving an inventive step (Article 33(2,3) PCT).

3. Independent Claim 3 and Claim 4

These claims are new and inventive for the same reasons as claim 2.
The invention as claimed in claim 3 differs from D2 in that reduction stages (5 and 7b) are direct coupled and the reduction stages (6 and 7a) are plurality ratios speed changing units.
The invention as claimed in claim 4 differs from D2 in that reduction stages (6 and 7a) are direct coupled and the reduction stages (5 and 7b) are plurality ratios speed changing units.

4. Independent Claim 5

The nearest prior art to claim 5 is disclosed in document D2, Figure 6.
Therein the variator is connected to the differentials (8,9) through a gear stage (4,6)
The invention differs therefrom in that there are at least four differentials connected to the variator by different gear ratios.
This is not obvious for a skilled person.

5. Independent Claim 19

The claim 19 claims the core IVT with two planetary sets wherein the input is connected to a first carrier and to the second ring and the output is connected to first ring and second carrier.

D3 or D4 are nearest prior art but the connections between the planetary sets are different and a skilled person is not able to modify these layouts to accede to the invention.

6. Dependent claims 6 to 18

The Claims 6 to 18 are dependent on claims 1 to 5 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

10/587552
IAP11 Rec'd PCT/PTO 27 JUL 2006

CLAIMS

1. Continuously variable mechanical transmission mechanism that allows extending the range of variation that contains

A) a core that comprises

a core input shaft (i) and a core output shaft (o);

a first differential (Da) and a second differential (Db),

a variator (V) connected to a first shaft (6) of the first differential (Da) and to a first shaft (7) of the second differential (Db), so that the variator (V) allows to regulate the proportion of the power that passes through each one of said differentials, from the core input shaft (i) to the core output shaft (o),

having each one of said first differential (Da) and second differential (Db) a second shaft connected to the core input shaft (i) and a third shaft connected to the core output shaft (o); and

B) an input shaft (i') of the mechanism configurated to be alternatively connected to the core input shaft (i) and to the core output shaft (o), and an output shaft (o') of the mechanism configurated to be alternatively connected to the core output shaft (o) and to the core input shaft (i), so that when the input shaft (i') of the mechanism is connected to the core input shaft (i), the output shaft (o') of the mechanism is connected to the core output shaft (o), and when the input shaft (i') of the mechanism is connected to the core output shaft (o), the output shaft (o') of the mechanism is connected to the core input shaft (i),

C) comprising the mechanism in addition four gear ratios units (R_{2n}, R_{2n+1}, S_{2n}, S_{2n+1}), each one comprising a multiplicity of gear ratios, being configurated the mechanism so that:

- the connection between the input shaft (i') of the mechanism and the core input shaft (i) is done via a first (R_{2n}) of said gear ratio units and according to a gear ratio selected from said unit,

- the connection between the input shaft (i') of the mechanism and the core output shaft (o) is done via a second (R_{2n+1}) of said gear ratio units and according to a gear ratio selected from said unit,

- the connection between the output shaft (o') of the mechanism and the core input shaft (i) is done via a third (S_{2n+1}) of said gear ratio units and according to a gear ratio selected from said unit,

- the connection between the output shaft (o') of the mechanism and the core output shaft (o) is done via a fourth (S_{2n}) of said gear ratio units and

according to a gear ratio selected from said unit.

2. Continuously variable mechanical transmission mechanism, that contains

an input shaft (i) and an output shaft (o);

a first differential (Dc) and a second differential (Dd),

a variator (V) configurated so that it allows gear ratios to be obtained between 0 and ∞ between an input shaft and an output shaft of the variator (V), so that it allows gear ratios to be obtained among a gear ratio in which the output shaft remains blocked while the input shaft rotates freely and a gear ratio in which the input shaft is blocked while the output shaft rotates freely, being the variator (V) connected to a first shaft (6) of the first differential (Dc) and to a first shaft (7) of the second differential (Dd);

two sets (R_{1i}, R_{2j}) of gear ratios units each one comprising a plurality of gear ratios and with a clutch or connection system configurated so that it is possible to connect in a selective mode a gear ratio within each set (R_{1i}, R_{2j}), so that it remains connected,

being the input shaft (i) joined to a second shaft of the first differential (Dc), and being the output shaft (o) joined to a second shaft of the second differential (Dd),

being one of the sets (R_{1i}) disposed so that any of its gear ratios may be connected between a third shaft (8) of the first differential (Dc) and the first shaft (7) of the second differential (Dd), and being the other of the sets (R_{2j}) disposed so that any of its gear ratios may be connected between a third shaft (9) of the second differential (Dd) and the first shaft (6) of the first differential (Dc).

3. Continuously variable mechanical transmission mechanism, that contains

an input shaft (i) and an output shaft (o);

a first differential (Dc) and a second differential (Dd),

a variator (V) configurated so that it allows gear ratios to be obtained between 0 and ∞ between an input shaft and an output shaft of the variator (V), so that it allows gear ratios to be obtained among a gear ratio in which the output shaft remains blocked while the input shaft rotates freely and a gear ratio in which the input shaft is blocked while the output shaft rotates freely, being

the variator (V) connected to a first shaft (6) of the first differential (Dc) and to a third shaft (8) of the first differential (Dc);

characterized in that also comprises

two sets (R_{1i}, R_{2j}) of gear ratios units each one comprising a plurality of gear ratios and with a clutch or connection system configurated so that it is possible to connect in a selective mode a gear ratio within each set (R_{1i}, R_{2j}), so that it remains connected,

being the input shaft (i) joined to a second shaft of the first differential (Dc), and being the output shaft (o) joined to a second shaft of the second differential (Dd),

being one of the sets (R_{1i}) disposed so that any of its gear ratios may be connected between a third shaft (8) of the first differential (Dc) and the first shaft (7) of the second differential (Dd), and being the other of the sets (R_{2j}) disposed so that any of its gear ratios may be connected between a third shaft (9) of the second differential (Dd) and the first shaft (6) of the first differential (Dc).

4. Continuously variable mechanical transmission mechanism, that contains

an input shaft (i) and an output shaft (o);

a first differential (Dc) and a second differential (Dd),

a variator (V) configurated so that it allows gear ratios to be obtained between 0 and ∞ between an input shaft and an output shaft of the variator (V), so that it allows gear ratios to be obtained among a gear ratio in which the output shaft remains blocked while the input shaft rotates freely and a gear ratio in which the input shaft is blocked while the output shaft rotates freely, being the variator (V) connected to a first shaft (7) of the second differential (Dd) and to a third shaft (9) of the second differential (Dd);

characterized in that also comprises

two sets (R_{1i}, R_{2j}) of gear ratios units each one comprising a plurality of gear ratios and with a clutch or connection system configurated so that it is possible to connect in a selective mode a gear ratio within each set (R_{1i}, R_{2j}), so that it remains connected,

being the input shaft (i) joined to a second shaft of the first differential (Dc), and being the output shaft (o) joined to a second shaft of the second differential (Dd),

being one of the sets (R_{1i}) disposed so that any of its gear ratios may be connected between a third shaft (8) of the first differential (Dc) and the first shaft (7) of the second differential (Dd), and being the other of the sets (R_{2j}) disposed so that any of its gear ratios may be connected between a third shaft (9) of the second differential (Dd) and the first shaft (6) of the first differential (Dc).

5. Continuously variable mechanical transmission mechanism, that contains

an input shaft (i) and an output shaft (o);

a plurality of differentials (D_1, D_2, D_{2n-1}, D_{2n}), that comprises a plurality of even differentials (D_2, D_{2n}) and a plurality of odd differentials (D_1, D_{2n-1});

a variator (V) configurated so that it allows gear ratios to be obtained between 0 and ∞ between an input shaft and an ouput shaft of the variator (V), so that it allows gear ratios to be obtained among a gear ratio in which the output shaft remains blocked whilst the input shaft rotates freely and a gear ratio in which the input shaft remains blocked while the output shaft rotates freely, being the variator (V) connected to a shaft (6) and to a shaft (7),

being the input shaft (i) joined to a first shaft of all the differentials (D_1, D_2, D_{2n-1}, D_{2n}), and being the output shaft (o) joined to a second shaft of all the differentials (D_1, D_2, D_{2n-1}, D_{2n}),

a plurality of sets (R_1, R_2, R_{2n-1}, R_{2n}) of gear ratios, that comprises a plurality of even sets (R_2, R_{2n}) and a plurality of odd sets (R_1, R_{2n-1}), comprising each one a plurality of gear ratios and with means of connections or clutches configurated so that it is possible to connect in a selective mode a gear ratio within each set (R_1, R_2, R_{2n-1}, R_{2n}), so that it remains connected,

being the sets (R_1, R_2, R_{2n-1}, R_{2n}) disposed so that the gear ratios of each one of the odd sets (R_1, R_{2n-1}) may be connected between a third shaft of each one of the odd differentials (D_1, D_{2n-1}) and the shaft (6) connected to the variator (V), and being the sets (R_1, R_2, R_{2n-1}, R_{2n}) disposed so that the gear ratios of each one of the even sets (R_2, R_{2n}) may be connected between a third shaft of each one of the even differentials (D_2, D_{2n}) and the shaft (7) connected to the variator (V).

6. Mechanism as claimed in any of claims 1 to 5, wherein the characteristics of its differentials and of its gear ratios have been selected so

that it produces a continuously variable gear ratio from zero to a maximum value.

7. Mechanism as claimed in any of claims 1 to 5, wherein the characteristics of its differentials and of its gear ratios have been selected so that it produces a continuously variable gear ratio from a minimum negative value to a maximum positive value passing through zero and reversing the rotation direction.

8. Mechanism as claimed in any of claims 2 to 7, wherein the output shaft (o) of the mechanism is connectable to a shaft in a selective way by a direct connection or by a set of gears which reverse the rotation direction.

9. Mechanism as claimed in claim 1, wherein the output shaft (o) of the mechanism is connectable to a shaft in a selective way by a direct connection or by a set of gears which reverse the rotatios direction.

10. Continuously variable mechanical transmission mechanism, that comprises

a mechanism for low range, that comprises a mechanism such as described in any of claims 2 to 8, for gear ratios where it is necessary to limit the output torque so that the maximum permitted is not exceeded,

and in addition comprises

a mechanism for high range, for gear ratios where the output torque is always lower than the maximum permitted torque without need for any limitation, that comprises a mechanism that allows extending the range of variation that contains

A) a core that comprises

a core input shaft (i) and a core output shaft (o);

a first differential (Da) and a second differential (Db),

a variator (V) connected to a first shaft (6) of the first differential (Da) and to a first shaft (7) of the second differential (Db), so that the variator (V) allows to regulate the proportion of the power that passes through each one of said differentials, from the core input shaft (i) to the core output shaft (o),

having each one of said first differential (Da) and second differential (Db) a second shaft connected to the core input shaft (i) and a third shaft connected

to the core output shaft (o); and

B) an input shaft (i') of the mechanism configurated to be alternatively connected to the core input shaft (i) and to the core output shaft (o), and an output shaft (o') of the mechanism configurated to be alternatively connected to the core output shaft (o) and to the core input shaft (i), so that when the input shaft (i') of the mechanism is connected to the core input shaft (i), the output shaft (o') of the mechanism is connected to the core output shaft (o), and when the input shaft (i') of the mechanism is connected to the core output shaft (o), the output shaft (o') of the mechanism is connected to the core input shaft (i),

C) comprising the mechanism in addition four gear ratios units (R_{2n}, R_{2n+1}, S_{2n}, S_{2n+1}), each one comprising a multiplicity of gear ratios, being configurated the mechanism so that:

- the connection between the input shaft (i') of the mechanism and the core input shaft (i) is done via a first (R_{2n}) of said gear ratio units and according to a gear ratio selected from said unit,

- the connection between the input shaft (i') of the mechanism and the core output shaft (o) is done via a second (R_{2n+1}) of said gear ratio units and according to a gear ratio selected from said unit,

- the connection between the output shaft (o') of the mechanism and the core input shaft (i) is done via a third (S_{2n+1}) of said gear ratio units and according to a gear ratio selected from said unit,

- the connection between the output shaft (o') of the mechanism and the core output shaft (o) is done via a fourth (S_{2n}) of said gear ratio units and according to a gear ratio selected from said unit.***>

11. Continuously variable mechanical transmission mechanism as claimed in claim 10, wherein the minimum gear ratio of the high range mechanism is equal to the maximum gear ratio of the low range mechanism.

12. Continuously variable mechanical transmission mechanism as claimed in claim 10, wherein in the region of minimum gear ratios of the high range mechanism and the region of maximum gear ratios of the low range mechanism there is overlapping with gear ratios common to both.

13. Continuously variable mechanical transmission mechanism as claimed in any of claims 10 to 12, wherein the transition between the low range and

high range is performed by suitable clutch or connection at the time when the gear ratio of both coincide.

14. Continuously variable mechanical transmission mechanism as claimed in any of claims 10 to 13, that contains an only speed variator (V) for both the high range mechanism and the low range mechanism.

15. Mechanism as claimed in any of the preceding claims, wherein the variator (V) consists of two electric machines that can work indiscriminately as a generator or as an engine and controlled by electronic circuits.

16. Mechanism as claimed in claim 15, in a machine with heat engine, e.g. motor vehicles, wherein the electric machines which comprise the variator are a starting motor of the machine and an electric generator to charge a battery of the machine.

17. Mechanism as claimed in any of the preceding claims, wherein one of the gear ratios of the sets is zero, and it is embodied by the possibility of braking or blocking one of the shafts that it connects, doing so joined to a chassis of the mechanism.

18. Continuously variable mechanical transmission mechanism, as claimed in claim 5, wherein one of the shafts (6) or (7) of the variator (V) is directly connectable to the output shaft (o) via a gear ratio (R_1) which can be activated or deactivated by means of a clutch or any other type of suitable connection.

19. Continuously variable mechanical transmission mechanism, that contains

a core that comprises

a core input shaft (i) and a core output shaft (o);

a first differential (Da) and a second differential (Db),

a variator (V) connected to a first shaft (6) of the first differential (Da) and to a first shaft (7) of the second differential (Db), so that the variator (V) allows to regulate the proportion of the power that passes through each one of said differentials, from the core input shaft (i) to the core output shaft (o),

having each one of said first differential (Da) and second differential (Db)

a second shaft connected to the core input shaft (i) and a third shaft connected to the core output shaft (o)

wherein said first differential (Da) is formed by a planet (1), a multiplicity of satellites (2) and a ring (3), and said second differential (Db) is formed by a planet (8), a multiplicity of satellites (5) and a ring (4), being the input shaft (i) simultaneously joined to the satellite carrier around which satellites (2) rotate and also joined to the ring (4), whilst the output shaft (o) is simultaneously joined to the satellite carrier around which satellites (5) rotate and is also joined to the ring (3), being the variator (V) connected so that it drives shafts (6) and (7), that are joined to the planets (1) and (8).